# M9416A VXT PXIe Vector Transceiver

380 MHz to 12 GHz


KEYSIGHT

# Table of Contents

# Technical Specifications

## Definitions and conditions

**Specifications** describe the warranted performance of calibrated instruments. Data represented in this document are specifications under the following conditions unless otherwise noted.

- Specifications are valid from 45 to 75 °C for individual module temperature, as reported by the module, and 20 to 35 °C for environment temperature unless otherwise noted
- Calibrated instrument has been stored for a minimum of 2 hours within the allowed operating range
- If instrument has previously been stored at a temperature range inside the allowed storage range, but outside the allowed operating range, instrument must have been stored for a minimum of 2 hours within the allowed operating range before turn-on
- 45-minute warm-up time with the Modular TRX application running
- Calibration cycle maintained
- When used with Keysight M9300A frequency reference and Keysight interconnect cables
- An “All Alignment” has been run within the previous 7 days
- A “Fast Alignment” has been run:
  - Within the previous 8 hours
  - If the environmental temperature has changed more than 5°C from the previous Fast Alignment

**Typical** describes additional product performance information that is not covered by the product warranty. It is performance beyond specifications that 95 percent of the units exhibit with a 95 percent confidence level. This data does not include measurement uncertainty and is valid only at room temperature (approximately 25 °C) after alignment within the stated alignment time and temperature limits.

**Nominal** values indicate expected performance or describe product performance that is useful in the application of the product but are not covered by the product warranty.

## Recommended best practices in use

- Use slot blockers and EMC filler panels in empty module slots to ensure proper operating temperatures. Keysight chassis and slot blockers optimize module temperature performance and reliability of test.
- Set chassis fan to high at environmental temperatures above 35 °C.

# Vector Signal Analyzer

| | | |
|---|---|---|
| **Performance** | | |
| **Capture depth** | | |
| Standard (Option M02) | 256 MSa of IQ data | |
| Option M05 | 512 MSa of IQ data | |
| **Frequency** | | |
| **Frequency range** | | |
| Option F06 | 380 MHz to 6 GHz | |
| Option F08 | 380 MHz to 8 GHz | |
| Option F12 | 380 MHz to 12 GHz | |
| **Frequency reference** | | |
| Accuracy, aging rate, stability | Refer to M9300A specifications | |
| **Frequency readout accuracy** | | |
| CW | ± (marker frequency x frequency reference accuracy + 0.10% x span + 5% x RBW + 2 Hz + 0.5 x horizontal resolution) | |
| Demodulation | ± (center frequency × frequency reference accuracy + 1 Hz) | |
| Resolution | 1 Hz | |
| **Analysis Bandwidth** | | |
| Standard (Option B4X) | 380 to 550 MHz | 100 MHz |
| | 550 MHz to 1.31 GHz | 200 MHz |
| | 1.31 to 12 GHz | 400 MHz |
| Option B8X | 380 to 550 MHz | 100 MHz |
| | 550 MHz to 1.31 GHz | 200 MHz |
| | 1.31 to 2 GHz | 600 MHz |
| | 2 to 12 GHz | 800 MHz |
| Option B12 | 380 to 550 MHz | 100 MHz |
| | 550 MHz to 1.31 GHz | 200 MHz |
| | 1.31 to 2 GHz | 600 MHz |
| | 2 to 12 GHz | 1.2 GHz |
| **Triggering** | | |
| **Trigger** | | |
| IQ analyzer | Free run, External 1, External 2, RF burst, Video, Periodic, PXI, Internal | |
| Trigger delay range | –150 to 500 ms | |
| Resolution | 1/sample rate | |
| **Maximum safe input level** | | |
| **Average power input** | | |
| RF input port | +27 dBm | |
| Option HDX, Half duplex port | +27 dBm | |
| **DC volts** | | |
| RF input port | 30 Vdc | |
| Option HDX, Half duplex port | 30 Vdc | |

| Absolute Amplitude Accuracy (CW mode) [1] | | | |
|---|---|---|---|
| **RF input port** | | | |
| Frequency Range | –70 dBm ≤ Input level < +10 dBm | +10 dBm ≤ Input level ≤ +20 dBm | +20 dBm < Input level ≤ +27 dBm |
| 380 MHz to 1.31 GHz | < ± 0.50 dB, < ± *0.20 dB typical* | < ± 0.60 dB, < ± *0.30 dB typical* | < ± 1.00 dB, < ± *0.70 dB typical* |
| 1.31 to 4.3 GHz | < ± 0.60 dB, < ± *0.25 dB typical* | < ± 0.65 dB, < ± *0.30 dB typical* | < ± 1.00 dB, < ± *0.65 dB typical* |
| 4.3 to 8.4 GHz | < ± 0.55 dB, < ± *0.25 dB typical* | < ± 0.55 dB, < ± *0.25 dB typical* | < ± 0.75 dB, < ± *0.40 dB typical* |
| 8.4 to 11.4 GHz | < ± 0.60 dB, < ± *0.30 dB typical* | < ± 0.80 dB, < ± *0.40 dB typical* | < ± 0.90 dB, < ± *0.50 dB typical* |
| 11.4 to 12 GHz | < ± 0.70 dB, < ± *0.35 dB typical* | < ± 0.85 dB, < ± *0.45 dB typical* | < ± 1.25 dB, < ± *0.70 dB typical* |
| **Half duplex port, Option HDX** | | | |
| Frequency Range | –70 dBm ≤ Input level < +10 dBm | +10 dBm ≤ Input level ≤ +20 dBm | +20 dBm < Input level ≤ +27 dBm |
| 380 MHz to 1.31 GHz | < ± 0.50 dB, < ± *0.25 dB typical* | < ± 0.60 dB, < ± *0.30 dB typical* | < ± 1.15 dB, < ± *0.85 dB typical* |
| 1.31 to 4.3 GHz | < ± 0.60 dB, < ± *0.25 dB typical* | < ± 0.65 dB, < ± *0.30 dB typical* | < ± 1.30 dB, < ± *0.80 dB typical* |
| 4.3 to 8.4 GHz | < ± 0.70 dB, < ± *0.30 dB typical* | < ± 0.60 dB, < ± *0.30 dB typical* | < ± 0.85 dB, < ± *0.50 dB typical* |
| 8.4 to 11.4 GHz | < ± 0.75 dB, < ± *0.40 dB typical* | < ± 0.75 dB, < ± *0.35 dB typical* | < ± 0.95 dB, < ± *0.55 dB typical* |
| 11.4 to 12 GHz | < ± 0.80 dB, < ± *0.40 dB typical* | < ± 0.90 dB, < ± *0.45 dB typical* | < ± 1.15 dB, < ± *0.65 dB typical* |

| Input Voltage Standing Wave Ratio (VSWR) | | |
|---|---|---|
| | **RF input port** | **Half Duplex Port (configured to input mode)** |
| 380 MHz to 4.3 GHz | < 1.55:1, < *1.4:1 typical* | < 1.55:1, < *1.4:1 typical* |
| 4.3 to 5.8 GHz | < 1.4:1, < *1.3:1 typical* | < 1.55:1, < *1.4:1 typical* |
| 5.8 to 7.2 GHz | < 1.8:1, < *1.6:1 typical* | < 1.9:1, < *1.7:1 typical* |
| 7.2 to 10.2 GHz | < 1.6:1, < *1.4:1 typical* | < 1.6:1, < *1.4:1 typical* |
| 10.2 to 12 GHz | < 2.0:1, < *1.9:1 typical* | < 2.0:1, < *1.9:1 typical* |

| Displayed Average Noise Floor (DANL) [2] | | |
|---|---|---|
| | **RF input port, with analyzer ranged to –70 dBm** | **Half duplex port, Option HDX, with analyzer ranged to –70 dBm** |
| 380 MHz to 4.3 GHz | –165 dBm, *–167 dBm typical* | –160 dBm, *–162 dBm typical* |
| 4.3 to 10.2 GHz | –165 dBm, *–167 dBm typical* | –158 dBm, *–161 dBm typical* |
| 10.2 to 12 GHz | –162 dBm, *–165 dBm typical* | –155 dBm, *–157 dBm typical* |

| Third-order Intermodulation Distortion (TOI, with analyzer ranged to +10 dBm) | |
|---|---|
| 380 MHz to 4.3 GHz | +30 dBm, *+32 dBm typical* |
| 4.3 to 6 GHz | +28 dBm, *+30 dBm typical* |
| 6 to 12 GHz | +27 dBm, *+29 dBm typical* |

1. Signal is measured at 1.1 MHz offset from the center frequency, Otherwise, an IF flatness error must be added.
2. Input terminated, LNA on, log power average, and normalized to 1 Hz bandwidth.

| Phase Noise Sidebands (CF = 1 GHz) | |
|---|---|
| 1 kHz offset | –114 dBc/Hz, *–116 dBc/Hz typical* |
| 10 kHz offset | –128 dBc/Hz, *–130 dBc/Hz typical* |
| 100 kHz offset | –132 dBc/Hz, *–134 dBc/Hz typical* |
| 1 MHz offset | –135 dBc/Hz, *–137 dBc/Hz typical* |
| 10 MHz offset | –139 dBc/Hz, *–141 dBc/Hz typical* |

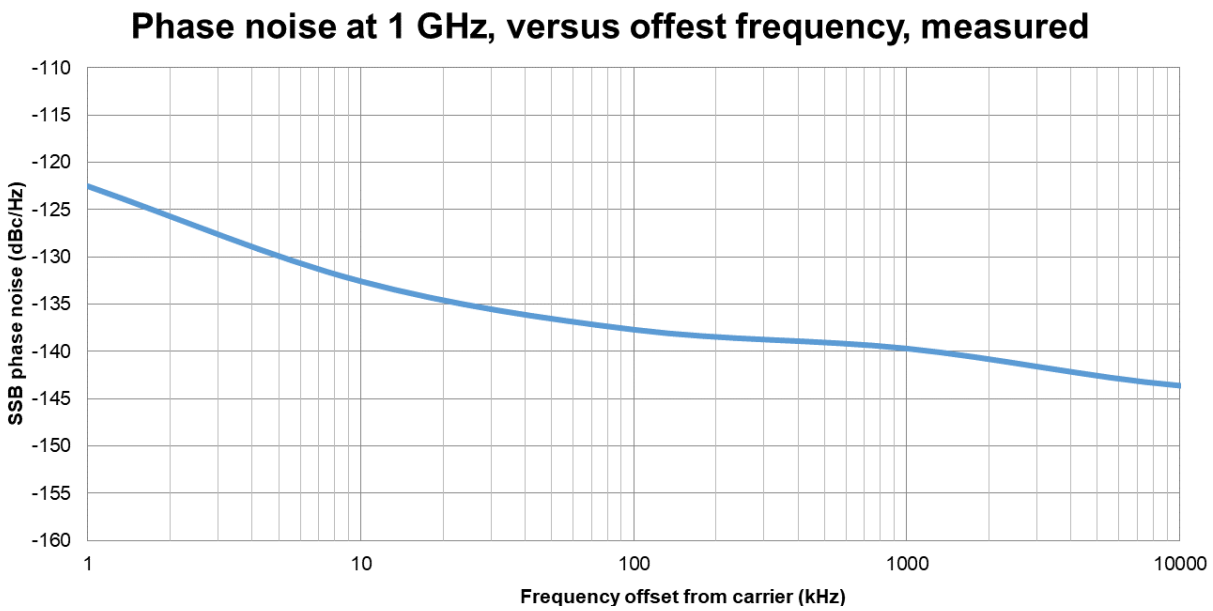


**Figure 1.** Phase noise from 1 kHz to 10 MHz offset at 1 GHz

| Spurious Responses | | | | | | |
|---|---|---|---|---|---|---|
| **Residual responses** | | | | | | |
| RF input port; Option HDX, half duplex port; with analyzer ranged to +10 dBm; offset from 10 MHz to 1/2 × analysis bandwidth | | | | | | |
| 380 MHz to 9 GHz | < –79 dBm, < *–82 dBm typical* | | | | | |
| 9 to 9.6 GHz | < –76 dBm, < *–80 dBm typical* | | | | | |
| 9.6 to 12 GHz | < –81 dBm, < *–83 dBm typical* | | | | | |
| **Image responses, nominal** | | | | | | |
| Center frequency | 100 MHz BW | 200 MHz BW | 400 MHz BW | 600 MHz BW | 800 MHz BW | 1.2 GHz BW |
| 380 to 550 MHz | –63 dBc | N/A | N/A | N/A | N/A | N/A |
| 550 MHz to 1.31 GHz | –62 dBc | –60 dBc | N/A | N/A | N/A | N/A |
| s1.31 to 2 GHz | –62 dBc | –60 dBc | –60 dBc | –60 dBc | N/A | N/A |
| 2 to 4.3 GHz | –62 dBc | –60 dBc | –60 dBc | –60 dBc | –58 dBc | –56 dBc |
| 4.3 to 4.6 GHz | –63 dBc | –63 dBc | –60 dBc | –60 dBc | –58 dBc | –56 dBc |
| 4.6 to 12 GHz | –63 dBc | –63 dBc | –60 dBc | –60 dBc | –59 dBc | –58 dBc |
| **Sideband spurs, nominal** | | | | | | |
| 1 kHz to 10 MHz offset | –85 dBc | | | | | |

| LO Feedthrough (dBr [1]) | | |
|---|---|---|
| | **RF input port, with analyzer ranged from –30 to +27 dBm** | **Option HDX, half duplex port, with analyzer ranged from –25 to +27 dBm** |
| 380 MHz to 12 GHz | –52 dBr, *–62 dBr typical* | –52 dBr, *–62 dBr typical* |

**IF Flatness**

**RF input port, –25 dBm ≤ Input level ≤ +10 dBm, typical indicated by *italics***

| Center frequency | 100 MHz BW | 200 MHz BW | 400 MHz BW | 600 MHz BW | 800 MHz BW | 1.2 GHz BW |
|---|---|---|---|---|---|---|
| 380 to 550 MHz | ± 0.90 dB,<br>*± 0.50 dB* | N/A | N/A | N/A | N/A | N/A |
| 550 MHz to 1.31 GHz | ± 0.70 dB,<br>*± 0.35 dB* | ± 0.70 dB,<br>*± 0.40 dB* | N/A | N/A | N/A | N/A |
| 1.31 to 1.62 GHz | ± 0.70 dB,<br>*± 0.35 dB* | ± 0.70 dB,<br>*± 0.40 dB* | ± 1.20 dB,<br>*± 0.70 dB* | ± 1.50 dB,<br>*± 0.95 dB* | N/A | N/A |
| 1.62 to 2 GHz | ± 0.70 dB,<br>*± 0.35 dB* | ± 0.70 dB,<br>*± 0.40 dB* | ± 0.65 dB,<br>*± 0.30 dB* | ± 0.65 dB,<br>*± 0.30 dB* | N/A | N/A |
| 2 to 3.5 GHz | ± 0.50 dB,<br>*± 0.15 dB* | ± 0.55 dB,<br>*± 0.25 dB* | ± 0.65 dB,<br>*± 0.30 dB* | ± 0.65 dB,<br>*± 0.30 dB* | ± 0.60 dB,<br>*± 0.25 dB* | ± 0.75 dB,<br>*± 0.35 dB* |
| 3.5 to 4.3 GHz | ± 0.55 dB,<br>*± 0.20 dB* | ± 0.55 dB,<br>*± 0.25 dB* | ± 0.80 dB,<br>*± 0.40 dB* | ± 0.80 dB,<br>*± 0.40 dB* | ± 0.80 dB,<br>*± 0.40 dB* | ± 0.85 dB,<br>*± 0.45 dB* |
| 4.3 to 12 GHz | ± 1.00 dB,<br>*± 0.50 dB* | ± 1.00 dB,<br>*± 0.50 dB* | ± 1.10 dB,<br>*± 0.65 dB* | ± 1.15 dB,<br>*± 0.70 dB* | ± 1.15 dB,<br>*± 0.70 dB* | ± 1.25 dB,<br>*± 0.80 dB* |

**Half duplex port, Option HDX, –25 dBm ≤ Input level ≤ +10 dBm, typical indicated by *italics***

| Center frequency | 100 MHz BW | 200 MHz BW | 400 MHz BW | 600 MHz BW | 800 MHz BW | 1.2 GHz BW |
|---|---|---|---|---|---|---|
| 380 to 550 MHz | ± 0.90 dB,<br>*± 0.55 dB* | N/A | N/A | N/A | N/A | N/A |
| 550 MHz to 1.31 GHz | ± 0.70 dB,<br>*± 0.35 dB* | ± 0.80 dB,<br>*± 0.40 dB* | N/A | N/A | N/A | N/A |
| 1.31 to 1.62 GHz | ± 0.70 dB,<br>*± 0.35 dB* | ± 0.80 dB,<br>*± 0.40 dB* | ± 1.15 dB,<br>*± 0.70 dB* | ± 1.55 dB,<br>*± 0.95 dB* | N/A | N/A |
| 1.62 to 2 GHz | ± 0.70 dB,<br>*± 0.35 dB* | ± 0.80 dB,<br>*± 0.40 dB* | ± 0.60 dB,<br>*± 0.30 dB* | ± 0.60 dB,<br>*± 0.30 dB* | N/A | N/A |
| 2 to 3.5 GHz | ± 0.45 dB,<br>*± 0.15 dB* | ± 0.55 dB,<br>± 0.25 dB | ± 0.60 dB,<br>*± 0.25 dB* | ± 0.60 dB,<br>*± 0.25 dB* | ± 0.65 dB,<br>*± 0.30 dB* | ± 0.70 dB,<br>*± 0.35 dB* |
| 3.5 to 4.3 GHz | ± 0.50 dB,<br>*± 0.20 dB* | ± 0.60 dB,<br>*± 0.20 dB* | ± 0.75 dB,<br>*± 0.40 dB* | ± 0.75 dB,<br>*± 0.40 dB* | ± 1.00 dB,<br>*± 0.55 dB* | ± 1.35 dB,<br>*± 0.80 dB* |
| 4.3 to 12 GHz | ± 0.85 dB,<br>*± 0.40 dB* | ± 1.00 dB,<br>*± 0.50 dB* | ± 1.10 dB,<br>*± 0.60 dB* | ± 1.25 dB,<br>*± 0.70 dB* | ± 1.30 dB,<br>*± 0.75 dB* | ± 1.35 dB,<br>*± 0.80 dB* |

1. dBr is LO feedthrough power relative to the range level of the receiver.

# Vector Signal Generator

| Performance | | |
|---|---|---|
| **Arb sample memory (storage capacity)** | | |
| Standard (Option M02) | 256 MSa of IQ data | |
| Option M05 | 512 MSa of IQ data | |
| **Frequency range** | | |
| Option F06 | 380 MHz to 6 GHz | |
| Option F08 | 380 MHz to 8 GHz | |
| Option F12 | 380 MHz to 12 GHz | |
| **Frequency reference** | | |
| Accuracy, aging rate, stability | Refer to M9300A specifications | |
| **Frequency accuracy** | | |
| ± (output frequency × frequency reference accuracy + 0.001 Hz) | | |
| **Frequency switching speed** [1] | | |
| SCPI mode | ≤ 14 ms nominal | |
| IVI mode | ≤ 6 ms nominal | |
| **Signal generation bandwidth** | | |
| | **Center frequency** | **Maximum bandwidth** |
| Standard (Option B4X) | 380 to 550 MHz | 100 MHz |
| | 550 MHz to 1.31 GHz | 200 MHz |
| | 1.31 to 12 GHz | 400 MHz |
| Option B8X | 380 to 550 MHz | 100 MHz |
| | 550 MHz to 1.31 GHz | 200 MHz |
| | 1.31 to 2 GHz | 600 MHz |
| | 2 to 12 GHz | 800 MHz |
| Option B12 | 380 to 550 MHz | 100 MHz |
| | 550 MHz to 1.31 GHz | 200 MHz |
| | 1.31 to 2 GHz | 600 MHz |
| | 2 to 12 GHz | 1.2 GHz |
| **Output level range (CW mode)** | | |
| **RF output port** | | |
| 380 MHz to 12 GHz | –120 to +5 dBm | |
| **Option HDX, half duplex port (configured to output mode)** | | |
| 380 MHz to 12 GHz | –120 to +5 dBm | |
| **RF output port, Option 1EA** | | |
| 380 MHz to 12 GHz | –120 to +20 dBm, +25 dBm settable | |
| **Option HDX, half duplex port (configured to output mode), Option 1EA** | | |
| 380 MHz to 12 GHz | –120 to +10 dBm | |
| **Maximum reverse power** | | |
| Average power input | +27 dBm | |
| DC volts | 30 Vdc | |
| **Amplitude switching speed** [1] | | |
| SCPI mode | ≤ 10 ms nominal | |
| IVI mode | ≤ 5 ms nominal | |

1. Switching speed depends highly upon the hardware and controller that is used. Measurements were made with the M9416A in an M9018B chassis with the M9037A embedded controller, Windows 10 Operating System.

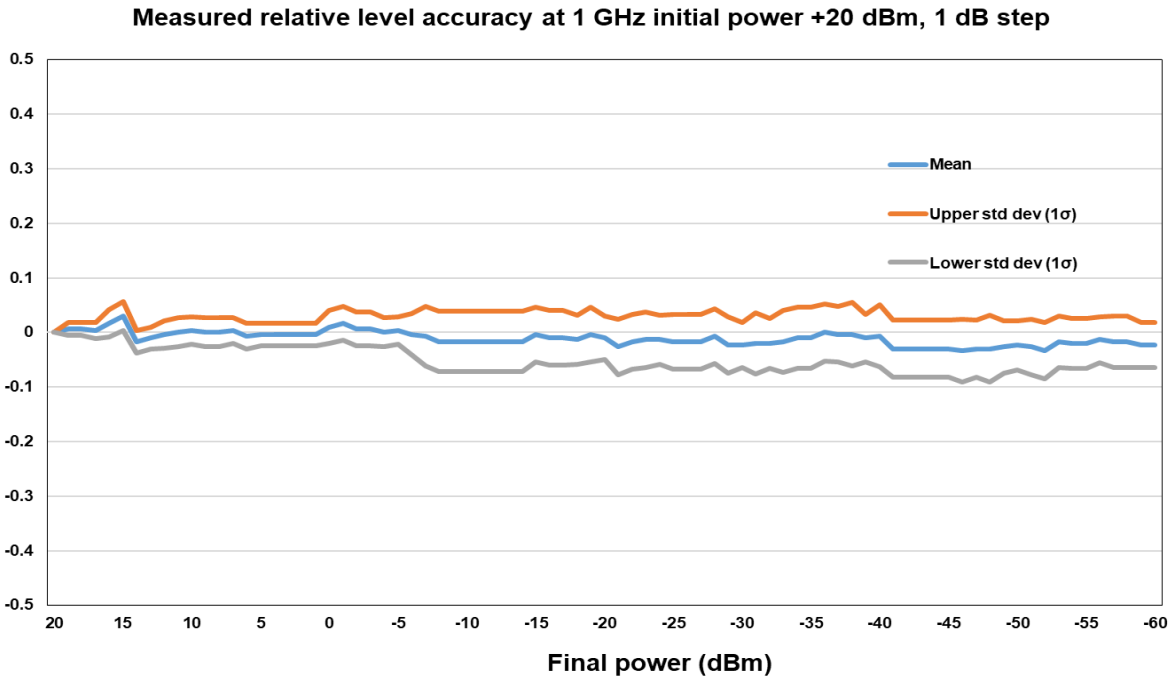


**Figure 2.** Measured relative level accuracy at 1 GHz

| **Absolute level accuracy (CW mode)** | | | | | | |
|---|---|---|---|---|---|---|
| **RF output port, typical indicated by *italics*** | | | | | | |
| Frequency range | 380 to 550 MHz | 550 MHz to 4.3 GHz | 4.3 to 6 GHz | 6 to 7.8 GHz | 7.8 to 10.2 GHz | 10.2 to 12 GHz |
| +10 dBm < Level ≤ +20 dBm | < ± 0.60 dB, < ± *0.25 dB* | < ± 0.75 dB, < ± *0.35 dB* | < ± 0.90 dB, < ± *0.45 dB* | < ± 1.00 dB, < ± *0.45 dB* | < ± 0.85 dB, < ± *0.45 dB* | < ± 0.85 dB, < ± *0.45 dB* |
| 0 dBm < Level ≤ +10 dBm | < ± 0.55 dB, < ± *0.25 dB* | < ± 0.65 dB, < ± *0.30 dB* | < ± 0.80 dB, < ± *0.40 dB* | < ± 0.85 dB, < ± *0.45 dB* | < ± 0.75 dB, < ± *0.35 dB* | < ± 0.65 dB, < ± *0.30 dB* |
| –60 dBm ≤ Level ≤ 0 dBm | < ± 0.55 dB, < ± *0.25 dB* | < ± 0.55 dB, < ± *0.25 dB* | < ± 0.60 dB, < ± *0.25 dB* | < ± 0.60 dB, < ± 0.20 dB | < ± 0.75 dB, < ± *0.25 dB* | < ± 0.70 dB, < ± *0.20 dB* |
| –90 dBm ≤ Level < –60 dBm | < ± 0.55 dB, < ± *0.25 dB* | < ± 0.55 dB, < ± *0.25 dB* | < ± 0.65 dB, < ± *0.35 dB* | < ± 0.95 dB, < ± *0.50 dB* | < ± 0.75 dB, < ± *0.35 dB* | < ± 1.00 dB, < ± *0.50 dB* |
| –100 dBm ≤ Level < –90 dBm | < ± 0.75 dB, < ± *0.35 dB* | < ± 0.75 dB, < ± *0.40 dB* | < ± 0.70 dB, < ± *0.30 dB* | < ± 0.95 dB, < ± *0.50 dB* | < ± 0.75 dB, < ± *0.35 dB* | < ± 1.10 dB, < ± *0.50 dB* |
| –110 dBm ≤ Level < –100 dBm | < ± 0.85 dB, < ± *0.45 dB* | < ± 0.90 dB, < ± *0.55 dB* | < ± 0.90 dB, < ± *0.50 dB* | < ± 0.95 dB, < ± *0.55 dB* | < ± 0.85 dB, < ± *0.45 dB* | < ± 1.10 dB, < ± *0.60 dB* |

| Option HDX, half duplex port, typical indicated by *italics* | | | | | | |
|---|---|---|---|---|---|---|
| Frequency range | 380 to 550 MHz | 550 MHz to 4.3 GHz | 4.3 to 6 GHz | 6 to 7.8 GHz | 7.8 to 10.2 GHz | 10.2 to 12 GHz |
| 0 dBm < Level ≤ +10 dBm | < ± 0.50 dB, < ± *0.20 dB* | < ± 0.50 dB, < ± *0.20 dB* | < ± 0.65 dB, < ± *0.30 dB* | < ± 0.55 dB, < ± *0.25 dB* | < ± 0.60 dB, < ± *0.25 dB* | < ± 0.70 dB, < ± *0.40 dB* |
| –60 dBm ≤ Level ≤ 0 dBm | < ± 0.50 dB, < ± *0.20 dB* | < ± 0.55 dB, < ± *0.25 dB* | < ± 0.65 dB, < ± *0.30 dB* | < ± 0.50 dB, < ± *0.25 dB* | < ± 0.70 dB, < ± *0.25 dB* | < ± 0.70 dB, < ± *0.30 dB* |
| –90 dBm ≤ Level < –60 dBm | < ± 0.50 dB, < ± *0.20 dB* | < ± 0.55 dB, < ± *0.25 dB* | < ± 0.65 dB, < ± *0.30 dB* | < ± 0.55 dB, < ± *0.25 dB* | < ± 0.55 dB, < ± *0.25 dB* | < ± 0.60 dB, < ± *0.25 dB* |
| –100 dBm ≤ Level < –90 dBm | < ± 0.65 dB, < ± *0.35 dB* | < ± 0.65 dB, < ± *0.35 dB* | < ± 0.55 dB, < ± *0.25 dB* | < ± 0.55 dB, < ± *0.25 dB* | < ± 0.55 dB, < ± *0.25 dB* | < ± 0.60 dB, < ± *0.30 dB* |
| –110 dBm ≤ Level < –100 dBm | < ± 0.80 dB, < ± *0.40 dB* | < ± 0.95 dB, < ± *0.55 dB* | < ± 0.70 dB, < ± *0.40 dB* | < ± 0.70 dB, < ± *0.40 dB* | < ± 0.65 dB, < ± *0.40 dB* | < ± 0.80 dB, < ± *0.50 dB* |

| **Measured amplitude repeatability** | |
|---|---|
| **RF output port, 0 dBm output power, 1 GHz, 24 hours elapsed time without alignment, 25 °C** | |
| Delta from initial value | < ± 0.10 dB nominal |
| **Setting resolution** | |
| 0.01 dB | |
| **Output Voltage Standing Wave Ratio (VSWR)** | |
| **RF output port** | |
| 380 MHz to 1.31 GHz | < 1.90:1, < *1.70:1 typical* |
| 1.31 to 7.8 GHz | < 1.75:1, < *1.65:1 typical* |
| 7.8 to 10.2 GHz | < 1.75:1, < *1.60:1 typical* |
| 10.2 to 12 GHz | < 2.00:1, < *1.70:1 typical* |
| **Option HDX, half duplex port (configured to output mode)** | |
| 380 MHz to 1.31 GHz | < 1.90:1, < *1.75:1 typical* |
| 1.31 to 6 GHz | < 1.75:1, < *1.40:1 typical* |
| 6 to 10.2 GHz | < 1.65:1, < *1.50:1 typical* |
| 10.2 to 12 GHz | < 1.90:1, < *1.55:1 typical* |
| **Harmonics** | |
| **RF output port** | |
| 0 dBm output power | |
| 380 MHz to 4.3 GHz | < –41 dBc, < *–45 dBc typical* |
| 4.3 to 5.8 GHz | < –36 dBc, < *–42 dBc typical* |
| 5.8 to 10.2 GHz | < –34 dBc, < *–39 dBc typical* |
| 10.2 to 12 GHz | < –41 dBc, < *–46 dBc typical* |
| +10 dBm output power, with Option 1EA | |
| 380 MHz to 4.3 GHz | < –31 dBc, < *–35 dBc typical* |
| 4.3 to 5.8 GHz | < –27 dBc, < *–33 dBc typical* |
| 5.8 to 9 GHz | < –26 dBc, < *–31 dBc typical* |
| 9 to 10.2 GHz | < –24 dBc, < *–29 dBc typical* |
| 10.2 to 12 GHz | < –29.5 dBc, < *–35 dBc typical* |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Option HDX, half duplex port, –5 dBm output power** | | | | | | |
| 380 MHz to 4.3 GHz | < –36 dBc, < *–40 dBc typical* | | | | | |
| 4.3 to 5.8 GHz | < –33 dBc, < *–38 dBc typical* | | | | | |
| 5.8 to 10.2 GHz | < –32 dBc, < *–37 dBc typical* | | | | | |
| 10.2 to 12 GHz | < –36 dBc, < *–42 dBc typical* | | | | | |
| **Non-harmonic spurious (CW mode)** | | | | | | |
| **RF output port, Option HDX, half duplex port, 0 dBm output power** | | | | | | |
| 380 MHz to 4.3 GHz | < –65 dBc, < *–70 dBc typical* | | | | | |
| 4.3 to 6.5 GHz | < –47 dBc, < *–52 dBc typical* | | | | | |
| 6.5 to 9.6 GHz | < –57 dBc, < *–62 dBc typical* | | | | | |
| 9.6 to 11.4 GHz | < –50 dBc, < *–56 dBc typical* | | | | | |
| 11.4 to 12 GHz | < –51 dBc, < *–60 dBc typical* | | | | | |
| **LO feedthrough** | | | | | | |
| **RF output port, Option HDX, half duplex port, 0 dBm output power** | | | | | | |
| 380 MHz to 1.31 GHz | –51 dBc, *–65 dBc typical* | | | | | |
| 1.31 to 1.62 GHz | –46 dBc, *–59 dBc typical* | | | | | |
| 1.62 to 2 GHz | –44 dBc, *–58 dBc typical* | | | | | |
| 2 to 4.3 GHz | –42 dBc, *–54 dBc typical* | | | | | |
| 4.3 to 12 GHz | –46 dBc, *–52 dBc typical* | | | | | |
| **Image responses** | | | | | | |
| **RF output port, 0 dBm output power, typical indicated by *italics*** | | | | | | |
| Center frequency | 100 MHz BW | 200 MHz BW | 400 MHz BW | 600 MHz BW | 800 MHz BW | 1.2 GHz BW |
| 380 to 550 MHz | –55 dBc, *–61 dBc* | N/A | N/A | N/A | N/A | N/A |
| 550 MHz to 1.31 GHz | –54 dBc, *–60 dBc* | –54 dBc, *–59 dBc* | N/A | N/A | N/A | N/A |
| 1.31 to 2 GHz | –53 dBc, *–59 dBc* | –52 dBc, *–58 dBc* | –51 dBc, *–57 dBc* | –49 dBc, *–54 dBc* | N/A | N/A |
| 2 to 12 GHz | –52 dBc, *–58 dBc* | –51 dBc, *–57 dBc* | –51 dBc, *–54 dBc* | –50 dBc, *–54 dBc* | –49 dBc, *–53 dBc* | –46 dBc, *–50 dBc* |
| **Option HDX, half duplex port, 0 dBm output power, typical indicated by *italics*** | | | | | | |
| Center frequency | 100 MHz BW | 200 MHz BW | 400 MHz BW | 600 MHz BW | 800 MHz BW | 1.2 GHz BW |
| 380 to 550 MHz | –55 dBc, *–61 dBc* | N/A | N/A | N/A | N/A | N/A |
| 550 MHz to 1.31 Hz | –54 dBc, *–60 dBc* | –53 dBc, *–57 dBc* | N/A | N/A | N/A | N/A |
| 1.31 to 2 GHz | –51 dBc, *–58 dBc* | –50 dBc, *–57 dBc* | –50 dBc, *–56 dBc* | –49 dBc, *–55 dBc* | N/A | N/A |
| 2 to 12 GHz | –51 dBc, *–57 dBc* | –49 dBc, *–58 dBc* | –48 dBc, *–54 dBc* | –48 dBc, *–53 dBc* | –47 dBc, *–51 dBc* | –45 dBc, *–48 dBc* |

| Sideband spurious | | | | |
|---|---|---|---|---|
| **RF output port, Option HDX, half duplex port, 0 dBm output power** | | | | |
| Offset | 380 MHz to 4.3 GHz | 4.3 to 6 GHz | 6 to 10.2 GHz | 10.2 to 12 GHz |
| 1 to 100 kHz | –70 dBc,<br>*–76 dBc typical* | –66 dBc,<br>*–72 dBc typical* | –62 dBc,<br>*–69 dBc typical* | –60 dBc,<br>*–65 dBc typical* |
| 100 kHz to 1 MHz | –89 dBc,<br>*–95 dBc typical* | –86 dBc,<br>*–92 dBc typical* | –84 dBc,<br>*–89 dBc typical* | –70 dBc,<br>*–75 dBc typical* |
| 1 to 10 MHz | –90 dBc,<br>*–96 dBc typical* | –88 dBc,<br>*–94 dBc typical* | –87 dBc,<br>*–93 dBc typical* | –81 dBc,<br>*–86 dBc typical* |
| **Phase noise** | | | | |
| **RF output port, 0 dBm; Option HDX, half duplex port, 0 dBm; Option 1EA, +10 dBm; Center frequency = 1 GHz** | | | | |
| 1 kHz offset | –105 dBc/Hz, *–115 dBc/Hz typical* | | | |
| 10 kHz offset | –126 dBc/Hz, *–133 dBc/Hz typical* | | | |
| 100 kHz offset | –134 dBc/Hz, *–139 dBc/Hz typical* | | | |
| 1 MHz offset | –141 dBc/Hz, *–145 dBc/Hz typical* | | | |
| 10 MHz offset | –142 dBc/Hz, *–145 dBc/Hz typical* | | | |

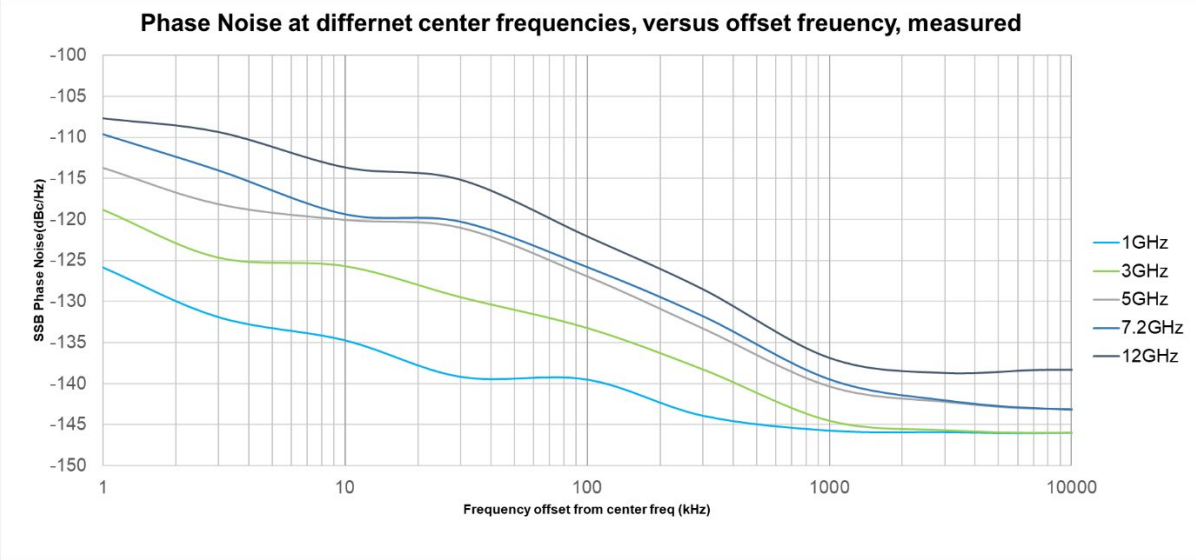


**Figure 3.** Measured phase noise from 1 kHz to 10 MHz offset at 1, 3, 5, 7.2 and 12 GHz

| Broadband noise floor [1] | |
|---|---|
| **RF output port, output level = 0 dBm** | |
| 380 to 550 MHz | –131 dBm/Hz, *–135 dBm/Hz typical* |
| 550 MHz to 4.3 GHz | –133 dBm/Hz, *–137 dBm/Hz typical* |
| 4.3 to 10.2 GHz | –131 dBm/Hz, *–135 dBm/Hz typical* |
| 10.2 to 12 GHz | –133 dBm/Hz, *–136 dBm/Hz typical* |
| **Option HDX, half duplex port, output level = –10 dBm** | |
| 380 to 550 MHz | –142 dBm/Hz, *–147 dBm/Hz typical* |
| 550 MHz to 4.3 GHz | –143 dBm/Hz, *–147 dBm/Hz typical* |
| 4.3 to 10.2 GHz | –139 dBm/Hz, *–144 dBm/Hz typical* |
| 10.2 to 12 GHz | –141 dBm/Hz, *–145 dBm/Hz typical* |

1. Measured at 10.1 MHz offset from the center frequency.

| Third-order Intermodulation distortion (TOI) | |
|---|---|
| **RF output port, output level = 0 dBm** | |
| 380 MHz to 7.8 GHz | +24 dBm, *+27 dBm typical* |
| 7.8 to 10.2 GHz | +23 dBm, *+25 dBm typical* |
| 10.2 to 12 GHz | +21 dBm, *+24 dBm typical* |
| **Option HDX, half duplex port, output level = 0 dBm** | |
| 380 to 550 MHz | +25 dBm, *+28 dBm typical* |
| 550 MHz to 4.3 GHz | +23 dBm, *+26 dBm typical* |
| 4.3 to 7.8 GHz | +20 dBm, *+24 dBm typical* |
| 7.8 to 10.2 GHz | +18 dBm, *+22 dBm typical* |
| 10.2 to 12 GHz | +17 dBm, *+20 dBm typical* |

**IF flatness**

**RF output port, –30 dBm ≤ Level ≤ +10 dBm, sample rate = 1.25 x bandwidth, typical indicated by *italics***

| Center frequency | 100 MHz BW | 200 MHz BW | 400 MHz BW | 600 MHz BW | 800 MHz BW | 1.2 GHz BW |
|---|---|---|---|---|---|---|
| 380 to 550 MHz | ± 0.80 dB,<br>*± 0.35 dB* | N/A | N/A | N/A | N/A | N/A |
| 550 to 680 MHz | ± 0.75 dB,<br>*± 0.25 dB* | ± 0.80 dB,<br>*± 0.40 dB* | N/A | N/A | N/A | N/A |
| 680 to 730 MHz | ± 0.75 dB,<br>*± 0.25 dB* | ± 0.80 dB,<br>*± 0.45 dB* | N/A | N/A | N/A | N/A |
| 730 MHz to 1.31 GHz | ± 0.65 dB,<br>*± 0.40 dB* | ± 0.75 dB,<br>*± 0.45 dB* | N/A | N/A | N/A | N/A |
| 1.31 to 1.62 GHz | ± 0.75 dB,<br>*± 0.40 dB* | ± 0.80 dB,<br>*± 0.40 dB* | ± 1.10 dB,<br>*± 0.75 dB* | ± 1.25 dB,<br>*± 0.90 dB* | N/A | N/A |
| 1.62 to 2 GHz | ± 0.65 dB,<br>*± 0.20 dB* | ± 0.65 dB,<br>*± 0.30 dB* | ± 0.65 dB,<br>*± 0.25 dB* | ± 0.80 dB,<br>*± 0.45 dB* | N/A | N/A |
| 2 to 3.5 GHz | ± 0.65 dB,<br>*± 0.30 dB* | ± 0.75 dB,<br>*± 0.45 dB* | ± 0.75 dB,<br>*± 0.45 dB* | ± 0.75 dB,<br>*± 0.45 dB* | ± 0.75 dB,<br>*± 0.45 dB* | ± 0.85 dB,<br>*± 0.55 dB* |
| 3.5 to 4.3 GHz | ± 0.65 dB,<br>*± 0.25 dB* | ± 0.65 dB,<br>*± 0.25 dB* | ± 0.90 dB,<br>*± 0.60 dB* | ± 1.25 dB,<br>*± 0.85 dB* | ± 1.25 dB,<br>*± 0.85 dB* | ± 1.30 dB,<br>*± 0.90 dB* |
| 4.3 to 6 GHz | ± 0.80 dB,<br>*± 0.40 dB* | ± 0.80 dB,<br>*± 0.45 dB* | ± 0.85 dB,<br>*± 0.50 dB* | ± 0.80 dB,<br>*± 0.55 dB* | ± 0.80 dB,<br>*± 0.55 dB* | ± 1.20 dB,<br>*± 0.85 dB* |
| 6 to 9 GHz | ± 0.75 dB,<br>*± 0.30 dB* | ± 0.75 dB,<br>*± 0.30 dB* | ± 0.75 dB,<br>*± 0.30 dB* | ± 0.70 dB,<br>*± 0.40 dB* | ± 0.75 dB,<br>*± 0.40 dB* | ± 0.80 dB,<br>*± 0.50 dB* |
| 9 to 10.2 GHz | ± 0.65 dB,<br>*± 0.20 dB* | ± 0.70 dB,<br>*± 0.25 dB* | ± 0.70 dB,<br>*± 0.35 dB* | ± 0.80 dB,<br>*± 0.40 dB* | ± 0.85 dB,<br>*± 0.45 dB* | ± 1.30 dB,<br>*± 0.75 dB* |
| 10.2 to 12 GHz | ± 0.80 dB,<br>*± 0.40 dB* | ± 0.80 dB,<br>*± 0.45 dB* | ± 0.85 dB,<br>*± 0.50 dB* | ± 0.90 dB,<br>*± 0.60 dB* | ± 0.90 dB,<br>*± 0.60 dB* | ± 0.90 dB,<br>*± 0.60 dB* |

| Half duplex port, Option HDX, –20 dBm ≤ Level ≤ +5 dBm, sample rate = 1.25 x bandwidth, typical indicated by *italics* | | | | | | |
|---|---|---|---|---|---|---|
| Center frequency | 100 MHz BW | 200 MHz BW | 400 MHz BW | 600 MHz BW | 800 MHz BW | 1.2 GHz BW |
| 380 to 550 MHz | ± 0.70 dB,<br>*± 0.35 dB* | N/A | N/A | N/A | N/A | N/A |
| 550 to 680 MHz | ± 0.60 dB,<br>*± 0.25 dB* | ± 0.70 dB,<br>*± 0.40 dB* | N/A | N/A | N/A | N/A |
| 680 to 730 MHz | ± 0.60 dB,<br>*± 0.25 dB* | ± 0.70 dB,<br>*± 0.40 dB* | N/A | N/A | N/A | N/A |
| 730 MHz to 1.31 GHz | ± 0.65 dB,<br>*± 0.45 dB* | ± 0.75 dB,<br>*± 0.50 dB* | N/A | N/A | N/A | N/A |
| 1.31 to 1.62 GHz | ± 0.70 dB,<br>*± 0.35 dB* | ± 0.75 dB,<br>*± 0.40 dB* | ± 1.00 dB,<br>*± 0.70 dB* | ± 1.15 dB,<br>*± 0.85 dB* | N/A | N/A |
| 1.62 to 2 GHz | ± 0.60 dB,<br>*± 0.25 dB* | ± 0.65 dB,<br>*± 0.25 dB* | ± 0.60 dB,<br>*± 0.20 dB* | ± 0.50 dB,<br>*± 0.35 dB* | N/A | N/A |
| 2 to 3.5 GHz | ± 0.60 dB,<br>*± 0.30 dB* | ± 0.65 dB,<br>*± 0.40 dB* | ± 0.65 dB,<br>*± 0.40 dB* | ± 0.65 dB,<br>*± 0.45 dB* | ± 0.65 dB,<br>*± 0.45 dB* | ± 0.65 dB,<br>*± 0.45 dB* |
| 3.5 to 4.3 GHz | ± 0.60 dB,<br>*± 0.35 dB* | ± 0.65 dB,<br>*± 0.35 dB* | ± 0.70 dB,<br>*± 0.45 dB* | ± 0.75 dB,<br>*± 0.50 dB* | ± 0.80 dB,<br>*± 0.55 dB* | ± 0.80 dB,<br>*± 0.55 dB* |
| 4.3 to 6 GHz | ± 0.65 dB,<br>*± 0.30 dB* | ± 0.70 dB,<br>*± 0.45 dB* | ± 0.85 dB,<br>*± 0.50 dB* | ± 0.75 dB,<br>*± 0.55 dB* | ± 0.75 dB,<br>*± 0.55 dB* | ± 1.10 dB,<br>*± 0.85 dB* |
| 6 to 9 GHz | ± 0.65 dB,<br>*± 0.35 dB* | ± 0.65 dB,<br>*± 0.35 dB* | ± 0.70 dB,<br>*± 0.40 dB* | ± 0.70 dB,<br>*± 0.40 dB* | ± 0.70 dB,<br>*± 0.45 dB* | ± 0.75 dB,<br>*± 0.50 dB* |
| 9 to 10.2 GHz | ± 0.55 dB,<br>*± 0.20 dB* | ± 0.65 dB,<br>*± 0.30 dB* | ± 0.80 dB,<br>*± 0.55 dB* | ± 0.80 dB,<br>*± 0.65 dB* | ± 1.00 dB,<br>*± 0.75 dB* | ± 1.15 dB,<br>*± 0.75 dB* |
| 10.2 to 12 GHz | ± 0.55 dB,<br>*± 0.20 dB* | ± 0.65 dB,<br>*± 0.30 dB* | ± 0.80 dB,<br>*± 0.45 dB* | ± 0.75 dB,<br>*± 0.50 dB* | ± 0.80 dB,<br>*± 0.55 dB* | ± 0.80 dB,<br>*± 0.50 dB* |

# General Specifications

| **Environmental characteristics** | |
|---|---|
| Operating temperature | 0 to +45 °C |
| Storage temperature | –40 to +65 °C |
| EMC | Complies with European EMC Directive 2014/30/EU<br>• IEC/EN 61326-1<br>• CISPR 11, Group 1, Class A<br>• AS/NZS CISPR 11<br>• ICES/NMB-001<br>This ISM device complies with Canadian ICES-001<br>Cet appareil ISM est conforme a la norme NMB-001 du Canada |
| Environmental stress | Samples of this product have been type tested in accordance with the Keysight Environmental Test Manual and verified to be robust against the environmental stresses of storage, transportation, and end-use; those stresses include, but are not limited to, temperature, humidity, shock, vibration, altitude, and power line conditions; test methods are aligned with IEC 60068-2 and levels are similar to MILPRF-28800F Class 3. |
| **Maximum power consumption** | |
| M9416A | 152 W nominal |
| **Weight** | |
| Net | 1.8 kg (4.0 lbs) |
| **Dimension** | |
| H x W x D | 130.2mm x 80.8mm x 209.6mm |
| **Warranty** | |
| The VXT PXIe vector transceiver is supplied with a 1-year warranty | |
| **Calibration cycle** | |
| The recommended calibration cycle is one year; calibration services are available through Keysight service centers | |

# Front Panel

| | |
|---|---|
| **Reference** | |
| Ref In, Ref Out | Frequency: 100 MHz |
| | Connector: MMPX female, 50 Ω nominal |
| | Lock range: ± 1 ppm, nominal |
| | Input amplitude: >+10 dBm, nominal |
| | Output amplitude: >+10 dBm, nominal |
| **LO reference** | |
| 2.4 GHz In, 2.4 GHz Out | Connector: MMPX female, 50 Ω nominal |
| | Input amplitude: >+10 dBm, nominal |
| | Output amplitude: >+12 dBm, nominal |
| **RF connections** | |
| RF Input | Connector: 3.5 mm female, 50 Ω nominal |
| RF Output | Connector: 3.5 mm female, 50 Ω nominal |
| Half Duplex | Connector: 3.5 mm female, 50 Ω nominal |
| **Trigger connections** | |
| Trigger 1, Trigger 2 (Input/Output, selectable) | Connector: MMPX female |
| | Input impedance: 1 kΩ or 50 Ω nominal |
| | Input level range: 0 to +3.3 V |
| | Output impedance: 50 Ω nominal |
| | Output level range: 3.3 V LVTTL |
| **DIO connections** | |
| Ctrl M, Ctrl S | Connector: Micro-HDMI female |
| | Level range: 3.3 V LVTTL, LVDS |

# WLAN Measurement Application Key Specifications

| | |
|---|---|
| **Modulated power** | |
| **Absolute power accuracy** | |
| 802.11be, 2.4 to 7.1 GHz | ± 0.4 dB nominal at 0 dBm input power |
| **Error Vector Magnitude (EVM)** | |
| **EVM floor conditions Phase Tracking on, Eq Smoothing on, Eq Training Seq only, RF output loopback to RF input, at –20 dBm input power, optimized range, nominal** | |
| 802.11ac 5.8 GHz 80 MHz | < –51 dB |
| 802.11ac 5.8 GHz 160 MHz | < –50 dB |
| 802.11ax 5.8 GHz 80 MHz | < –52 dB |
| 802.11ax 5.8 GHz 160 MHz | < –50 dB |
| 802.11ax 7 GHz 80 MHz | < –51 dB |
| 802.11ax 7 GHz 160 MHz | < –50 dB |
| **EVM floor conditions Phase Tracking on, Eq Smoothing on, Eq Training Seq only, RF output loopback to RF input, at –15 dBm input power, optimized range, nominal** | |
| 802.11be, 5 GHz, 160 MHz, 1024 QAM | < –50 dB |
| 802.11be, 5.8 GHz, 160 MHz, 1024 QAM | < –51 dB |
| 802.11be, 7 GHz, 160 MHz, 1024 QAM | < –50 dB |
| 802.11be, 5 GHz, 320 MHz, 4096 QAM | < –46 dB |
| 802.11be, 5.8 GHz, 320 MHz, 4096 QAM | < –47 dB |
| 802.11be, 7 GHz, 320 MHz, 4096 QAM | < –47 dB |

# WLAN Source Key Specifications

| Error Vector Magnitude (EVM) | |
|---|---|
| **RF output port, at –5 dBm to –15 dBm output power, nominal** | |
| 802.11ac 5.8 GHz 80 MHz | < –51 dB |
| 802.11ac 5.8 GHz 160 MHz | < –50 dB |
| 802.11ax 5.8 GHz 80 MHz | < –52 dB |
| 802.11ax 5.8 GHz 160 MHz | < –50 dB |
| 802.11ax 7 GHz 80 MHz | < –51 dB |
| 802.11ax 7 GHz 160 MHz | < –49 dB |
| **EVM floor conditions Phase Tracking on, Eq Smoothing on, Eq Training Seq only, RF output loopback to RF input, at –15 dBm input power, optimized range, nominal** | |
| 802.11be, 5 GHz, 160 MHz, 1024 QAM | < –50 dB |
| 802.11be, 5.8 GHz, 160 MHz, 1024 QAM | < –51 dB |
| 802.11be, 7 GHz, 160 MHz, 1024 QAM | < –50 dB |
| 802.11be, 5 GHz, 320 MHz, 4096 QAM | < –46 dB |
| 802.11be, 5.8 GHz, 320 MHz, 4096 QAM | < –47 dB |
| 802.11be, 7 GHz, 320 MHz, 4096 QAM | < –47 dB |

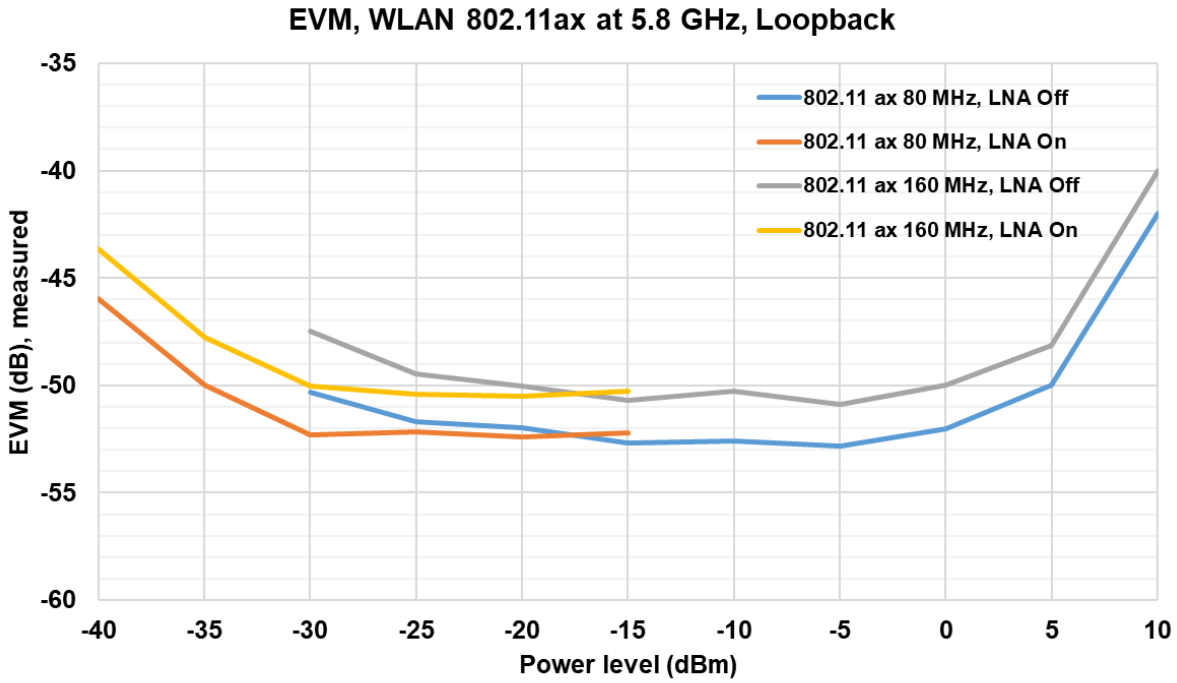


**Figure 4.** WLAN 802.11ax EVM vs. output power level at 5.8 GHz, loopback

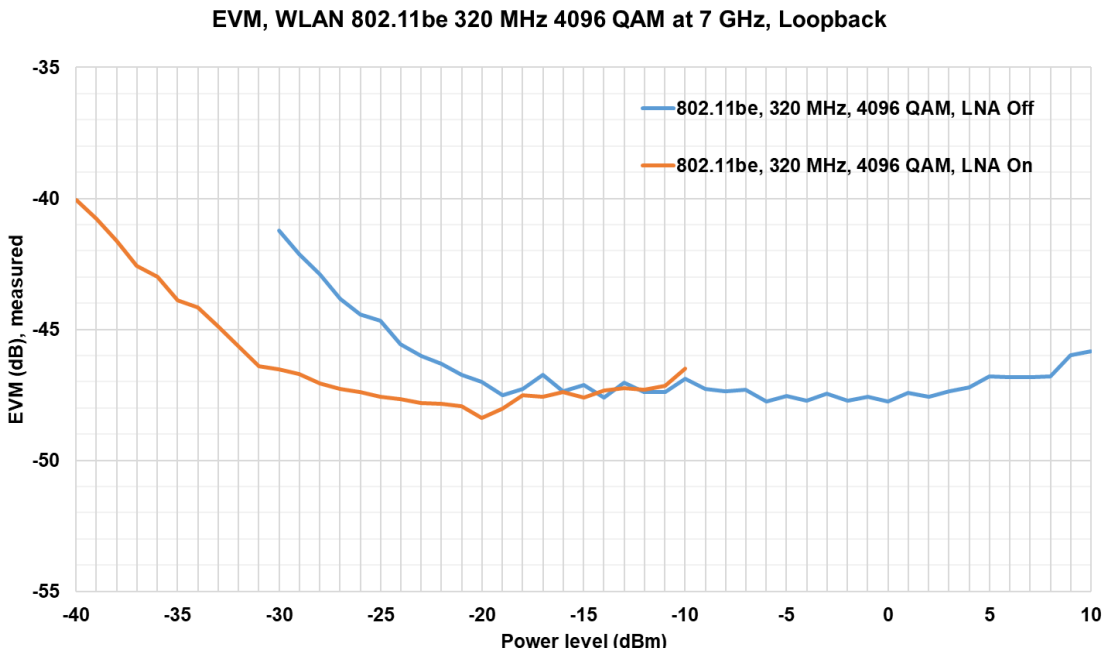


**Figure 5.** WLAN 802.11be EVM vs. output power level at 7 GHz, loopback

# Related Literature

For more detailed product and specification information refer to the following literature and web pages:

- M9416A VXT PXIe Vector Transceiver Configuration Guide (literature no. 3122-2155EN)
- M9300A PXIe Frequency Reference Data Sheet (literature no. 5991-0898EN)
- M9018B and M9019A PXIe 18 slot Chassis Data Sheet (literature no. 5992-1481EN)
- M9035A PXIe Embedded Controller Data Sheet (literature no. 3121-1327EN)
- M9037A PXIe Embedded Controller Data Sheet (literature no. 5991-3661EN)
- M9038A PXIe Embedded Controller Data Sheet (literature no. 3122-1717EN)
- X-Series Measurement Applications Brochure (literature no. 5989-8019EN)
- Signal Studio Software Brochure (literature no. 5989-6448EN)

# Web

Product page:

- www.keysight.com/find/M9416A